CMFRI Special Publication
Number 29

Exploitation of Marine Fishery Resources and its Contribution to Indian Economy

Central Marine Fisheries Research Institute
E. R. G. Road, Cochin 682031, India
Indian Council of Agricultural Research

CMFRI Special Publications

* 1. Pearl Culture Training : Long-term and short-term courses, 1977. 39 pp.

* 2. Mariculture Research and Developmental Activities, 1978. 48 pp.

3. Summer Institute in Breeding and Rearing of Marine Prawns, 1978. 128 pp.

* 4. Economics of the Indigenous Fishing Units at Cochin: A case study, 1978. 24 pp.

5. Seminar on the Role of Small Scale Fisheries and Coastal Aquaculture in Integrated Rural Development, 1978. 44 pp.

* 6. Coastal Aquaculture: Proceedings of the first workshop on technology transfer, 1979. 96 pp.

7. Manual of Research Methods for Crustacean Biochemistry and Physiology, 1981. 172 pp

* 8. Manual of Research Methods for Fish and Shellfish Nutrition, 1982. 125 pp.

9. Manual of Research Methods for Marine Invertebrate Reprcduction, 1982. 214 pp.

10. Analysis of Marine Fish Landings in India: A new approach, 1932. 42 pp.

1 2. A Code List of Common Marine Living Resources of the Indian Seas, 1983. 150 pp.

1 3. Application of Genetics in Aquaculture, 1983. 90 pp

Contd. inside back cover

*Out of print.

14. Manual of Research Methods for Invertebrate Endocrinology, 1983. 114 pp.

15. Production and Use of *Artemia* in Aquaculture, 1984. 74 pp.

16. Manual on Marine Toxins in Bivalve Molluscs and General Consideration of Shellfish Sanitation, 1984. 100 pp.

17. Handbook on Diagnosis and Control of Bacterial Diseases in Finfish and Shellfish Culture, 1984. 50 pp.

18. Proceedings of the Workshop on Sea Turle Conservations, 1984. 136 pp.

19. Mariculture Research Under the Centre of Advanced Studies in Mariculture, 1984. 109 pp.

20. Manual on Pearl Culture Techniques, 1984. 42 pp.

21. A guide to Prawn Farming in Kerala, 1985. 92 pp.

22. Water Quality Management in Aquaculture, 1985.96 pp.

23. Hatchery Production of Penaeid Prawn Seed : *Penaeus indicus*, 1985. 41 pp.

24. Present Status of Ribbonfish Fishery in India, 1986 50 pp.

25. A Practical Manual for Studies of Environmental Physiology and Biochemistry of Culturable Marine Organisms, 1986. 48 pp.

26. Theorems of Environmental Adaptations, 1986. 50 pp.

27. Bibliography of the Publications of CMFRI from 1948 to 1985, 1986. 168 pp.

28. Present Status of Our Knowledge on the Lesser Sardines of Indian Waters, 1986. 46 pp.

29. Exploitation of Marine Fishery Resources and its Contribution to Indian Economy, 1986. 40 pp.

Exploitation of Marine Fishery Resources and its Contribution to Indian Economy

CMFRI Special Publication
Number 29

Central Marine Fisheries Research Institute
E. R. G. Road, Cochin 682031, India
Indian Council of Agricultural Research
NOVEMBER 1986

Published by:
Dr. P. S. B. R. James
Director
Central Marine Fisheries
Research Institute
P.B. No. 2704
E.R.G. Road
Cochin 682031, India

Priated at
Amarakerala Industries, Cochin 18

PREFACE

The Central Marine Fisheries Research Institute, Cochin, has been publishing marine fish catch statistics periodically based on data collected through a stratified multi-stage random sampling design. A number of studies have also been made by the Institute on the socio-economics and related aspects of fishermen. Based on these results and other related documents the authors in this | special publication have studied the contribution of marine fisheries to the national economy.

This publication covers the all-India marine fish-catch trends, the employment generated through marine capture and culture fisheries, the value of the fish landed, which is needed for computation of national income from the sector, the total fuel consumption by mechanised vessels, the per capita availability of fish and the future plans to meet the demand. The publication draws attention to an area which needs continuous evaluation and monitoring keeping in view the changing scenario.

P. S. B. R. James
Director.

EXPLOITATION OF MARINE FISHERY RESOURCES AND ITS CONTRIBUTION TO INDIAN ECONOMY

E. G. SILAS, T. JACOB, K. ALAGARAJA AND K. BALAN
Central Marine Fisheries Research Institute, Cochin.

ABSTRACT

India possesses a long coastline, of about 6400 Km. Declaration of the Exclusive Economic Zone has resulted in about 2 million sq. km area of marine waterspread coming under the control of India, against its land area of about 3.2 million sq. km. The marine living resources of India are vast and varied, and the possible yield from these resources has in recent years opened up new vistas for their exploitation. This paper presents information on the status and means of exploitation of these resources, the exports and per-capita availability of marine products and their contribution to the national wealth.

There are 2408 fishing villages fringing the coastline of India, with 1414 fishlanding centres. According to the census carried out by Central Marine Fisheries Research Institute in 1980, the total marine fisherfolk population was about 2.1 million. There are 0.14 million indigenous craft comprising plank-built boats, dug-out canoes and catamarans. Mechanized boats number about 19000, of which 60% are trawlers.

The average annual marine fish landings in India during 1981-83 was estimated at 1.45 million tonnes. West coast accounted for 1.0 million tonnes and the east coast 0.45 million tonnes. Among the species/groups, oil sardines came first (14%) in terms of total landings. followed by bombayduck and penaeid prawns (7% each). Mechanized boats accounted for 63% of the landings and the non-mechanized for the rest.

The total value of fish at the landing-centre price worked out to Rs.5850 million, whereas at the consumer level it worked out to Rs. 12700 million. The export during 1983 was 86,170 tonnes and the value was Rs. 3623 million, about 87% of the total value accounting for by prawns only.

The total amount of diesel oil consumed by the mechanized craft worked out to about 200 million litres and the value of this to about Rs. 790 million.

The annual per-capita availability of marine fish was estimated at 4.57 kg, which is much below the requirement. On the basis of assumptions, a modest estimate of production requirement worked out to 2.32 million tonnes.

The potential yield from the Indian seas was estimated at 4.57 million tonnes, indicating a large scope for increasing the production. By enforcing proper regulatory measures and by diversification of fishing, the artisanal and small mechanized sector may be expected to increase the catches. Intensified effort is needed in two areas, namely the culture fishery and the off-shore capture fishery, in order to augment fish production.

INTRODUCTION

Surrounded by sea on three sides of the mainland, India has vast potentials in terms of marine living and nonliving resources. For ages India has been exploiting her seas, particularly by fishing, which has since been the traditional occupation of the country's coastal fishermen community. Exports of marine products are not new to this country. Exports of pearl to countries such as through the Gulf to the ancient Roman Empire are well documented in Indian history. There has been a well-established dried- and cured-fish trade with neighbouring countries since olden days. However, fishing as an industry did not progress enough to contribute to the national wealth till the Nineteen-fifties. The search for cheap protein and the advent of independence have paved the way for progressive onward march of this occupation, resulting in increased marine fish landings and, subsequently, in more export earnings. The recent declaration of the Exclusive Economic Zone has added a fillip for introducing larger vessels for exploiting marine fishery resources. Land areas being limited, their yielding capacity may not be able to be increased on a par with the growing food demands of millions over the globe. Hence all the maritime countries pay more and more attention to the vast seas to meet the demands, and India is no exception.

From the modest catch of about 0.56 million tonnes in the early fifties, the contribution from marine fish landings in India rose to 0.78 million tonnes in the sixties, to 1.12 million tonnes in the seventies and to 1.45 million tonnes in the early eighties (Silas et al, 1976; Mar. Fish. Inf. Serv, 1982). Afterward, in spite of the increase in efforts expended for fishing, there has been no relative increase in the catch, which indicates a limitation of the present exploited grounds. Hence, it has become imperative that if we should step up the yield from the sea any further we have to extend the area of exploitation and to bring in more species, both conventional and non-conventional, under it.

This paper presents the status of the exploited fishery resources, production means, exports and per-capita availability and the contribution of marine fish landings to the national wealth. The impact of mechanization on the small-scale fisheries sector is also discussed as well as indicating the potential yield and future prospects.

EXPLOITED MARINE FISHERY RESOURCES

The contribution to the marine fish yield comes from capture fisheries and culture fisheries. At present the yield from the capture fisheries is the major component. The Central Marine Fisheries Research Institute (CMFRI) collects data on marine fish landings and biological aspects, employing a stratified multistage, random-sampling design, and obtains areawise and resourcewise estimates of marine fish landings (Mar. Fish. Inf. Ser. 1983).

Average annual estimate of marine fish landings for 1981-83 is about 1.45 million tonnes from the capture fisheries. Statewise, Kerala (23%) ranks first in the production, followed by Maharashtra (18%), Tamil Nadu (17%), Gujarat (15%), Karnataka (10%), Andhra Pradesh (9%), Orissa (3%), Goa and West Bengal (2% each) and Pondicherry (1%) in that order.

Specieswise, oil sardine (14%) comes first; followed by the bombayduck, *Harpodon nehereus* (7%); penaeid prawns (7%); sciaenids and anchovies (6% each); silverbellies (5%); non-penaeid prawns, lesser sardines, elasmobranchs, catfish, and pomfrets (4% each); ribbonfish, perches and carangids (3% each); mackerel and seer fish (2% each); and tunnies (1%).

East coast contributes about 0.45 million tonnes, which form 31% of the total marine fish landings in India. The major species in this coast are silverbellies (14%); which is followed by

lesser sardines (11%); sciaenids and anchovies (7% each); elasmobranchs and penaeid prawns (6% each); perches (5%); ribbonfish (4%); and pomfrets, catfish, other clupeids, mackerel and seer fish (3% each).

In the west coast, dominant species are the oil sardine (20%), bombayduck (11%), penaeid prawns (8%), sciaenids and anchovies (6% each), non-penaeid prawns (5%), elasmobranchs and catfish (4%), pomfrets, ribbonfish and mackerel (3% each), seer fish (2%) and tunnies (1%). The detailed break-up of statewise and specieswise catches are given in Table 1.

The contribution of fish landings from non-mechanized units is about 37%. The states where the relative contribution from this sector is higher are Andhra Pradesh, Pondicherry and Kerala.

All the craft that are powered are considered to be mechanized units, which are classified into two major groups: smaller vessels (of length less than 17.3 m) and larger vessels (larger than 17.3 m). The smaller vessels are further classified into : the trawlers; the purse-seiners; and 'the rest', which includes gill netters, dol netters and the country craft fitted with outboard engines. Statewise break-up of contributions from mechanized and non-mechanized crafts are presented in Table 2, in which the corresponding efforts in terms of number of units operating are also given, in brackets. It may be seen that in Maharashtra, Gujarat, Karnataka and Goa the contributions are comparatively more from mechanised craft owing to the operation of 'dol' netters and trawlers in Maharashtra, of 'dol' netters, trawlers and gill netters in Gujarat and of purse seiners in Karnataka and Goa.

A number of larger vessels are put in commercial fishing by private firms. Apart from these, the Fishery Survey of India, the Integrated Fisheries Project and the Central Institute of Fisheries Nautical and Engineering Training are operating larger vessels for exploratory surveys and for training. The data from the commercial operations are mostly not available. But the

Table - 1. Statewise and specieswise annual

Name of fish	W. Bengal	Orissa	Andhra pradesh	Tamil Nadu
	1	2	3	4
1. ELASMOBRANCHS				
a. Sharks	352	1,896	4,749	2,742
b. Skates	159	6	334	447
c. Rays	295	457	1,740	12,469
2. EELS	16	40	469	153
3. CATFISHES	5,008	4,869	3,680	4,820
4. CLUPEIDS				
a. Wolf herring	606	1,153	1 429	2,399
b. Oil sardines	—	—	—	86
c Other sardines	15	4,637	15,664	28,288
d. Hilsa shad	1,587	1,210	83	263
e. Other shads	55	308	2,532	4,541
f. Anchovies				
Coilia	356	309	108	336
Setipinna	552	565	232	103
Stolephorus	32	353	9,297	9,259
Thrissina	—	—	—	—
Thryssa	115	216	3,067	5,592
g. Other clupeids	1,757	237	5,027	5,911
5. BOMBAYDUCK	2,282	189	1,152	4
6. LIZARDFISHES	—	242	1,274	1,738
7. HALFBEAKS & FULLBEAKS	—	1	48	990
8. FLYING FISHES	—	3	81	1,709
9. PERCHES				
a. Rock cods	4	65	26	1,160
b. Snappers	—	22	532	938
c. Pig-face breams	—	—	2	1,764
d. Threadfin breams	—	454	2,494	2,959
e. Other perches	33	396	4,166	4,22

marine fish landings (tonnes) in India during 1981–83.

Pondicherry	Kerala	Karnataka	Goa	Maharashtra	Gujarat	Andamans	Lakshadweep	Total
5	6	7	8	9	10	11	12	13
112	5,247	4,147	654	8,188	8,944	114	222	37,367
1	170	3	—	1,159	565	—	25	2,869
257	1,161	223	126	2,425	3,978	12	14	23,157
15	18	3	13	3,049	3,136	—	—	6,912
62	11,479	8,343	1,891	11,324	11,069	31	—	62,576
105	1,041	245	109	4,189	3,289	27	—	14,592
47	148,360	47,480	6,227	361	—	—	..	203,341
2,041	6,777	4,855	1,306	476	19	751	—	64,829
6	71	5	1	589	334	—	—	4,149
204	5	131	10	1,712	6,318	27	—	15,843
8	—	4	26	12,639	4,571	—	—	18,357
23	—	9	—	—	—	—	—	1,484
394	24,311	9,753	163	113	1,250	186	—	55,111
—	—	—	—	—	—	—	—	—
460	925	933	1,251	1,736	2,023	6	—	16,324
452	3,589	1,559	326	3,548	3,772	—	—	28,178
1	—	4	4	57,470	47,299	—	—	108,405
262	5,542	649	550	1,901	515	—	—	12,673
140	684	175	14	135	111	21	101	2,420
372	6	—	—	1	—	7	22	2,201
23	468	18	4	171	211	—	—	2,150
6	168	37	3	186	435	—	—	2,327
23	102	—	3	7	—	—	—	1,898
596	7,654	1,462	753	4,129	1,667	—	—	22,168
588	1,476	264	435	1,032	2,119	386	266	15,386

	1	2	3	4
10. GOAT FISHES	—	143	1,212	1,664
11. THREADFINS	162	225	1,348	334
12. CROAKERS	899	6,204	9,126	16,104
13. RIBBON FISHES	180	811	8,553	6,439
14 CARANGIDS				
a. Horse mackerel	—	165	598	75
b. Scads	—	123	3,340	896
c. Leather-jackets	183	115	892	1,595
d. Other carangids	4	232	2,434	8,644
15. SILVERBELLIES	33	818	7,714	55,212
16. BIG-JAWED JUMPER	—	24	918	618
17. POMFRETS				
a. Black pomfret	245	532	1,965	639
b. Silver pomfret	4,016	2,558	1,892	437
c. Chinese pomfret	215	5	68	30
18 MACKERELS				
a. Indian mackerel	2	1,153	4,250	4,740
b. Other mackerels	—	—	—	7
19. SEER FISHES				
a. *S. commersoni*	748	318	1,976	4,439
b. *S. guttatus*	171	1,543	3,144	446
c. *S. lineolatus*	—	22	4	89
d. *Acanthocybium* sp	—	—	—	3
20. TUNNIES				
a. *E. affinis*	—	179	522	2,366
b. *Auxis* spp.	—	3	3	285
c. *K. pelamis*	—	1	—	19
d *T. tonggol*	—	—	—	2
e. Other tunnies	—	49	115	342
21. BILL FISHES	—	2	257	177
22. BARRACUDAS	—	17	218	1,382
23. MULLETS	31	1	229	457
24. UNICORN COD	—	—	—	—

5	6	7	8	9	10	11	12	13
116	143	6	20	1,380	269	—	28	4,981
11	114	6	5	562	2,901	5	—	5,673
448	4,279	2,896	2,202	17,226	30,617	—	—	90,002
123	6,403	1,188	927	10,437	8,036	16	—	43,113
—	458	604	63	238	514	—	—	2,715
612	2,995	28	1	7	313	—	—	8,315
27	446	633	40	748	2,215	—	—	6,894
912	7,523	2,273	959	1,942	237	221	155	25,536
1,092	7,022	3,693	1,476	409	12	469	—	77,950
24	1,196	826	1,126	2,055	7,249	—	—	14,036
82	1,180	1,111	196	3,091	2,671	5	—	11,717
19	1,311	662	74	15,738	12,104	24	—	38,835
—	47	11	—	40	57	—	—	473
589	13,200	9,153	2,255	322	—	248	—	35,912
3	—	—			—	27	—	37
72	3,215	3,158	271	2,172	1,763	85	34	18,251
26	2,060	1,153	386	2,336	2,225	82	36	13,608
—	23	76	10	—	—	—	—	224
—	18	—		—	—	—	—	41
4	4,382	2,034	16	685	691	—	29	10,908
—	1,145	147	—	292	—	—	—	1,875
34	17	9	—	2	—	49	2,211	2,342
—	25	—	—	16	5	—	—	48
37	611	2	57	1,360	99	13	594	3,279
38	159	31	2	121	335	13	31	1,166
45	869	80	22	161	313	54	14	3,175
19	90	7	92	73	1,546	124	—	2,669
—	—	—	6	71	150	—	—	227

	1	2	3	4
25. FLAT FISHES				
a Halibut	—	—	68	271
b Flounders	—	—	417	16
c Soles	15	215	940	2,296
26 CRUSTACEANS				
a. Penaeid prawns	318	1,808	9,061	13,700
b. Nonpenaeid prawns	1,278	99	4,031	449
c Lobsters	—	15	10	302
d. Crabs	154	132	1,838	10,669
e. Stomatopods	15	153	398	1,097
27. MULLUSCS				
a Cephalopods	8	123	542	2,934
28. MISCELLANEOUS	1,726	788	2,282	16,528
TOTAL	23,627	38,204	128,551	249,379

Central Marine Fisheries Research Institute is making efforts to collect data from these operations also.

On the culture side, the yield comes from the traditional coastal aquaculture, mainly from Kerala, Karnataka, Goa and West Bengal. About 5200 ha of low-lying coastal areas in Kerala, called 'Pokkali' field, yield about 4800 tonnes. About 2300 ha at the 'Gazani' farms of Karnataka, mainly in the North Karnataka district, contribute about 600 tonnes. In Goa about 1800 ha of 'Khazan' lands contribute about 400 tonnes of fish and prawns. The 'Bheries' of West Bengal, with an area of about 20,000 ha, yield about 6,000 tonnes. All these put together, the total contribution from the traditional sector is about 12,000 tonnes of fish and prawns (Alagarswami 1981, Tripathi 1981).

EXPORT OF MARINE PRODUCTS

The export of marine products in 1981 amounted to 75,380 tonnes with a value of Rs. 2867 million In 1983, there is a sharp

5	6	7	8	9	10	11	12	13
5	166	5	6	417	334	—	—	1,272
3	15	23	243	25	—	--	—	742
232	9,805	1,467	488	2,314	2,498	—	—	20,270
311	26,243	6,568	4,490	30,553	11,060	54	—	104,166
26	110	1	—	41,932	5,849	—	—	53,775
21	71	16	14	481	584	2	—	1,516
621	330	729	722	305	8,157	17	—	23 684
4	4,398	8,783	2,778	1,308	3,269	—	—	22,203
83	2,546	466	218	4,383	3,246	—	17	14,566
6,782	11,791	2,378	2,378	5,567	8,061	119	215	56,961
12,571	328,651	139,928	35,409	265,309	219,015	3,196	4,014	1447,854

rise in export, hurling it to an all-time high (Prime 1984). This rise is in terms of both quantity and value; the quantity being 86170 tonnes and the value Rs 3623 million. The major contribution during 181-83 comes from prawns, which account for 69% in quantity and 87% in value, which is followed by fresh and frozen fish, accounting for about 16% in quantity and 5% in value.

VALUE OF THE PRODUCT

The income accrued from the exploited marine fishery resources is considered at two levels, namely production or landing-centre level and consumer or end-user level The prices at landing centres vary even within the course of a day, sometimes greatly, depending on the catch arrivals, availability of ice and demand. Neverthless, on the basis of the available data, an average price level for each category of fish is arrived at and, from which, the total value is obtained. The total value at the landing-centre level thus worked out amounts to Rs 5850 million. Statewise split-up of the estimates are given in Table 3·

Table-2 Statewise average annual contribution (tonnes) of marine fish landings by mechanised and non-mechanised units in India 1981-83.*

	Trawl	Purse-seine	others	Mechanised (total)	Non-mechanised
West Bengal	18	—	14683	14701	8926
	(—)		(59104)	(59104)	(104688)
Orissa	12603	—	7314	19917	18287
	(66616)		(97221)	(163837)	(714973)
Andra pradesh	36384	—	115	36499	92052
	(119280)		(14)	(119294)	(2511181)
Tamil Nadu	125750	—	2998	128748	120631
	(496398)		(14446)	(510844)	(3805090)
Pondicherry	4080	—	411	4491	8080
	(34016)		(2074)	(36090)	(270429)
Kerala	60150	13657	73735	147542	181109
	(320305)	(7621)	(245477)	(573403)	(2156544)
Karnataka	38794	77978	3660	120432	19496
	(174302)	(39443)	(28623)	(242368)	(241522)
Goa	19530	8430	1352	29312	6097
	(76212)	(10815)	(10847)	(97874)	(62922)
Maharashtra	87544	—	153763	241307	24002
	(141511)	—	(302783)	(444294)	(317774)
Gujarat	88705	—	71515	160220	58795
	(118112)		(237972)	(356084)	(551185)
Total	473558	100065	329546	903169	537475
	(1546752)	(57879)	(998561)	(2603192)	(10736308)

Note: Figures in brackets are the effort in terms of no. of unit days.

* Mostly smaller mechanised vessels.

Table: 3 State-wise value of average annual marine fish landings (1981 83) at landing centre price
(in million Rs.)

	State	Value
1.	West Bengal	110.8
2.	Orissa	187.6
3.	Andhra Pradesh	562.2
4.	Tamil Nadu	836.9
5.	Pondicherry	40.5
6.	Kerala	1138.6
7.	Karnataka	422.5
8.	Goa	179.8
9.	Maharashtra	1397.8
10.	Gujarat	943.7
11.	Andaman	11.0
12.	Lakshadweep	17.2
	Total	5848.6

The prices at the actual consumer level are difficult to obtain, as there are several stages through which this highly perishable commodity passes before it reaches the end-user. On the basis of the studies undertaken by C. M. F. R. I. (Panikkar and Sathiadhas 1982), it is observed that the best quality items like prawns, pomfrets and seer fish fetch 65 paise to the producer out of every rupee of the consumer. Similarly, the producer's share in the case of the medium quality fishes such as the perches and carangids and the oil sardine and silver-bellies are 50 and 35 paise, respectively. After the exported quantity as converted to its landing-centre weight is subtracted, the catch is valued on the basis of the above rates, and to this is added the value of the exported to obtain the final value at the consumer level. The value at the consumer level thus arrived at is Rs. 12,700 million.

Table-4 Statewise figures of marine fishing villages and fishermen population in India- 1980 Census*

Sl. No.	Items	STATES										
		West-Bengal	Orissa	Andra-pradesh	Tamil-Nadu	Pondi-cherry, Karaikal, Mahe & Yenam	Kerala	Karna-taka	Goa Daman Diu	Maha-rashtra	Guja-rat	Total
1.	Coast line (km)	600	480	982	1000		560	270	153	720	1663	6,428
2.	No. of fishing villages	200	236	453	422	27	304	147	61	373	179	2,408
3.	No. of landing centres	25	46	280	344	23	226	97	39	161	173	1,414
4.	No of fishermen households	9369	20,329	73,844	75,721	4,625	99,894	15,638	6,725	38,178	23,075	3,67,398
5.	Fishermen population	59,056	117,144	330,167	395,903	25,312	639,872	112,893	39,912	224,040	152,015	20,96,314
6.	No of fishermen engaged in actual fishing	13,869	30,724	84,445	96,500	5,512	131,101	25,005	8,871	43,237	36,527	4,74,731

*Excluding Andamans and Lakshadweep.

PRODUCTION MEANS

According to the census carried out by the Central Marine Fisheries Research Institute during 1980 (Mar. Fish. Inf. Ser. 1981), there are 2, 408 fishing villages on the 6400 km coast of the main land, with 1414 fish-landing centres. In these villages reside about 2.1 million fisherfolk (Table 4). Different types of craft and gear with different local names are in use in these villages. In this paper the craft and gear are given segregated into major categories.

Among the indigenous craft numbering about 1.41 lakh, catamarans are about 53%, plank-built boats 28% and dugout canoes 19%. There are about 19000 smaller mechanized craft, of which trawlers from 60%, gill netters 21% and 'Dol' netters 15%. Purse seiners, numbering about 430, are operating in the coastal waters of Kerala, Karnataka and Goa.

Drift/set gill nets, numbering about 3,79,000, fixed-bag nets about 66,000, boat seines about 30,000 and shore seines about 19,000 are used all along the coast. So also the trawl nets. But purse-seines are confined to Goa, Karnataka and Kerala only. The details of statewise distribution of craft and gear are given in Table 5.

MAN POWER

There are about 1.0 million persons engaged in marine fishing and allied activities, out of which 94% are engaged in capture fisheries and the rest in culture fisheries. Statewise and occupationwise breakups are given in Table 6. "Employment under capture fisheries" covers persons engaged in actual fishing activities, maintenance of infrastructure facilities and transportation "Fishing activities" includes actual fishing, net making and mending and fish trading at landing centres. "Infrastructure facilities" includes boat building yards, netmaking industry, ice plants, cold storages, processing units and fuel depots. "Transport" includes truck-plying for transportation of fish at different stages starting from landing centres.

Table-5. Statewise figures of marine fishing

Sl. No.	Items	STATES			
		West Bengal	Orissa	Andhra pradesh	Tamil Nadu
1.	No. of fishing crafts				
	(a) Mechanized				
	Trawlers	—	350	580	2,614
	Gill netters	740	119	—	143
	Dol netters	—	—	—	—
	Purse-seiners	—	—	—	—
	Others	—	—	—	—
	Total	740	469	580	2,757
	(b) Non-mechanized				
	Plank built boats	2,770	3,262	11,359	8,957
	Dug out canoes	88	186	1,781	2,210
	Catamarans	—	6,276	22,653	31,851
	Others	—	4	675	325
	Total	2,858	9,728	36,468	43,343
2.	No. of fishing gears				
	Trawl nets	—	760	1068	7083
	Purse seines		—	—	—
	Drift/gill nets	1,347	10,427	42,832	118,300
	Boat seines	—	2,676	9,744	7,220
	Fixed bag nets	5,048	2,778	14,631	1,842
	Hooks & Lines	625	15,265	10,752	22,111
	Rampans	—	—	—	—
	Shore seines	411	2,893	3,050	4,549
	Traps	60	515	130	8,919
	Scoop nets	345	37	2,925	1,040
	Others	2,147	5,201	37,199	6,339

Pondicherry, Karaikal, Mahe & Yanam	Kerala	Karnataka	Goa Daman, Diu	Maharashtra.	Gujarat	Total*
160	2,630	1,553	494	1,726	1,209	11,316
3	362	28	274	715	1,547	3,931
—	—	—	—	2,248	650	2,895
—	37	325	66	—	—	428
—	9	98	74	29	7	217
163	3,038	2,004	908	4,718	3,413	18,790
83	4,376**	1,747	1,108	2,445	3,040	39,147
72	10,415	4,454	1,397	4,759	1,080	26,442
1,595	11,480	23	8	—	—	73,886
—	—	718	—	436	—	2,158
1,750	26,271	6,942	2,513	7,640	4,120	140,833
397	5,133	3,437	937	4,955	2,291	26,061
—	40	353	70	—	—	463
1,851	23,307	6,571	3,346	163,902	7,383	379,266
375	9,779	23	165	—	—	29,982
152	—	941	430	18,754	2,1857	66,433
720	2,949	1,507	127	10,864	2,376	67,296
—	—	86	101	207	—	394
84	2,926	3,924	987	—	—	18,824
9	2,239	—	—	—	86,952+	98,824
362	1,371	—	—	—	—	6,080
120	2,761	10,925	2,813	49,247	28,013	144,765

* Excluding Andamans & Lakshadweep.

\+ Small sized noose ('fanse') meant for gobid fishing.

** During 1983, about 1500 plank built-boats in Kerala have been fitted with outboard engines.

Table-6 Statewise and itemwise employment details in marine fishing and allied activities in India.*

States	No. of persons engaged in capture fisheries activities						No. of persons engaged in culture fishery activities	Total persons engaged in culture and capture
	Arti-sanal	Small mechanized boats	Total	Infra-structure facilities	Trans-porta-tion etc.	Total for capture fisheries		
W. Bengal	27,072	2,960	30,032	602	2 525	33,159	40,000	73,159
Orissa	57,772	2,226	59,998	1,388	1,388	62,686	—	62,686
A. Pradesh	148,296	2,900	151,196	1,024	2,800	155,020	—	155,020
T. Nadu	143,761	13,642	157,403	1,807	3,360	162,570	—	162,570
Pondicherry	8,654	812	9,466	27	275	9,768	—	9,768
Kerala	199,266	15,522	214,788	10,472	3,250	228,510	10,240	238 750
Karnataka	40,157	16,069	56,226	3,272	3,100	62,598	4,640	67,238
Goa	17,681	5,446	23,127	96	1,540	24,763	3,600	28,363
Maharashtra	75,892	29,590	105,482	3,231	4,420	113,133	—	113,133
Gujarat	44,821	17,461	62,282	2,254	4,430	68,866	—	68,866
Larger trawlers	—	—	1,744	750	1,000	3,494	—	3,494
Total	763,372	106,628	871,744	24,823	28,000	924,567	58,480	983,047

*Excluding Andamans and Lakshadweep.

Table 6 also shows the distribution of persons engaged in fishing activities according to the three major groups of craft they are engaged in, namely artisanal craft, small mechanised boats and larger vessels. From this it may be seen that 88% of the manpower is employed in the artisanal sector. Out of this total artisanal-sector manpower, 26% is accounted for by Kerala, 19% each by Andhra Pradesh and by Tamil Nadu and 10% by Maharashtra. Under the small-mechanised boats sector Maharashtra contributes 28%, followed by Gujarat (16%), Karnataka (15%), Kerala (14%) and Tamil Nadu (13%). It may be noted that it is the 'Dol' netters in large numbers that has increased the contribution of Maharashtra and Gujarat.

FUEL CONSUMPTION

Fuel is one of the important inputs in mechanised sector. The quantity of fuel annually consumed by this sector is

Table-7 Annual fuel consumption ('000 l.) and its cost ('000 Rs.) in marine fishing operations in India.*

	Fuel consumption		Cost
	Diesel	Other oils	
West Bengal	1,781	30	6,895
Orissa	9,578	148	36,869
Andhra Pradesh	11,928	179	45,835
Tamil Nadu	50,073	752	192,417
Pondicherry	3,464	52	13,310
Kerala	35,275	4,214	147,132
Karnataka	23,801	394	91,952
Goa	9,461	152	36,490
Maharashtra	24,269	467	94,649
Gujarat	16,115	2355	68,708
Larger vessels	14,491	144	54,837
Total	200,236	8,887	789,094

*Excluding Andamans and Lakshadweep.

estimated separately for each maritime state based on the number of operations of each type of craft. Estimates of fuel consumption are given under two heads, namely 'diesel' and 'other oils'. 'Other oils' includes engine oil, petrol and kerosene, when petrol and kerosene are used such as in the operation of country craft fitted with outboard engines.

Out of the estimated 200 million litres of diesel oil consumed, Tamil Nadu accounts for 25% followed by Kerala (18%), Maharashtra (12%) and Gujarat (8%). The total value of the fuel works out to Rs. 789 million (Table 7).

PER-CAPITA AVAILABILITY AND DEMAND PROJECTIONS

Marine fish form an important item of food in the maritime states, meeting part of the population's protein requirements. It is therefore useful to assess the availability of marine fish vis a vis the nutritional requirements. The procedure adopted to estimate the supply and demand is as follows.

The total availability for local consumption is arrived at by estimating and subtracting the portions going for export and for reduction into fishmeal and other products from the total landings. The exported portion is estimated on the basis of the categorywise average export figures of 1981-83, allowing for losses in processing. For the portion that may have been reduced into fishmeal, etc, 4% of the remaining is assigned. The final estimate thus arrived at is 1.28 million tonnes.

The per-capita availability is estimated on the basis of the projected census for 1983. Since all persons do not eat fish/meat, the percentage population that eat fish/meat are worked out for each State on the basis of theNational Commission on Agriculture 1976 (Table 8).

Table-8. Maritime statewise per-capita availability and demand projection of marine fish in India.

Sl. No.	States	Population in millions.	% of fish or meat eating people	No. of fish/ meat eating people (millions)	Availability for local consumption (tonnes)	Annual per-capita availability (kg)	Annual demand (tonnes) (1) West Bengal @ 1.0 kg/head. Other states @ 7.0 kg/head	Annual demand (tonnes) (2) W. B. @ 1·5 kg/ head Other states 10.0 kg/head.
1.	West Bengal	58.24	95	55.33	22,334	0.40	55,330	82,995
2.	Orissa	27.83	80	22 26	34,701	1.56	155,820	222,600
3.	Andhra Pradesh	57.05	80	45.64	113,513	2.49	319,480	456,400
4.	Tamil Nadu	50.79	80	40.63	224,442	5.52	284,410	406,400
5.	Pondicherry	0.65	80	0.52	11,728	22.55	3,640	5,200
6.	Kerala	26.85	80	21.48	286,844	13.35	150,360	214,800
7.	Karnataka	39.98	80	31.98	127,158	3.98	223,860	319,800
8.	Goa	1.17	80	0.94	29,089	30.94	6,580	9,400
9.	Maharashtra	67.28	70	47.10	221,330	4.70	329,700	471,006
10.	Gujarat	36.73	35	12.86	198,176	15.41	90,020	128,600
11.	Andamans	0.22	80	0.18	3,009	16.72	1,260	1,800
12.	Lakshadweep	0.04	90	0.04	3,853	96.33	280	400
	Total	366.63		278.96	12,76,180	4.57	16,21,100	23.19,295

for working out the details. Annual per-capita availability of marine fish is thus estimated at 4.57 kg.

The maximum per-capita availability is in Lakshadweep (96.3 kg), which is followed by Goa, Pondicherry, Andamans, Gujarat, Kerala, Tamil Nadu and Maharashtra. All the other states have per-capita availability below the all-India level, with West Bengal the least (Table 8). The highest per-capita availability in Lakshadweep is due to relatively more catch and less population. However, the entire quantity produced here is not consumed locally, but a part of which is sent over to the mainland. In the case of West Bengal the population is relatively high and the landings are low, and the needs are mostly met from inland fish production.

The per-capita demand is estimated as follows According to the Nutrition Advisory Committee of the I. C. M. R. (Gopalan et al, 1971), balanced diet for non-vegetarian adults should include 30 g of meat and fish and 30 g of egg per day. Assuming 20 g of this meat and fish requirement has to come from fish, and allowing 40% for cleaning losses, the requirement of whole-fish works out to 12.2 kg per annum per adult. For children, the requirement is 30 g of meat, fish and egg put together, out of which for meat and fish, the requirement may be assumed to be 15 g Here again, on the lines followed for adults, the requirement of whole fish works out to 6.1 kg per annum per child. The per-capita requirement is worked out from the weighted average on the child-adult ratio of 40:60, which comes to 10 kg. The marine-fish requirement is taken as 2/3 of 10 kg for all states except West Bengal, where it is 1/10, since its fish requirement is mainly met from inland waters. Accordingly, the per-capita demand of marine fish in West Bengal and in each of the other states are 1.0 and 7.0 kg, respectively, and the annual demand projection comes to 1.62 million tonnes for local consumption. This is a very conservative estimate as seen from the assumptions on which the estimate has been obtained.

In the above estimations it is assumed that the egg requirement is fully met otherwise But considering the food

habits of common man in the maritime states and the availability of eggs, it may be assumed that 50% of the egg requirement too is to be met by marine fish. If so the per-capita requirement comes to 1.5 kg for West Bengal and 10.0 kg each for the other states. On this basis the projection works out to 2.32 million tonnes of fish for local consumption.

It may be interesting to work out the per-capita availability and requirement of fish, both marine and inland, on all-India level. At present the quantity available from inland resources is estimated at 0.9 million tonnes, Hence the total quantity available for consumption is about 2.18 million tonnes. Per-capita availability for the total Indian population works out to 3.0 kg per annum against the modest requirement of 7.0 kg. However, if we consider only the fish/meat-eating population (80%) then the per capita availability works out to 3.8 kg. To meet actual the per-capita nutritional demand, the production for local consumption should be of the order of 4.11 million tonnes, which is far above the present production.

IMPACT OF MECHANIZATION ON TRADITIONAL FISHERFOLK

It has been noticed that, in spite of the increase in intensity of exploitation by mechanised boats, there is no corresponding increase in the total landings. This clearly indicates that contribution from traditional sector is experiencing a set back. In this connection it may be noted that in the country there are three different systems, functionally viz. one in which the mechanised sector competes with traditioual sector, one in which the mechanised sector is complementary to the traditional sector, and, lastly, one of traditional sector being motorised. The latter two have resulted in the improvement of the income of traditional fisher folk.

A study conducted by C.M.F.R I. on the socio-economic background of the fishermen families in Puthiappa-Puthian-

gadi villages in Kerala state (Panikkar and Alagaraja 1981) clearly indicates the improvement of economic conditions of fishermen families in the region which received credit facilities from ARDC to acquire mechanised boats. Eventhough the direct beneficiaries of this scheme are 200 families, constituting only one-fourth of the total population, the whole fishermen community in this area has been benefited, the others having received the spill-over benefits. Further, this is characterized by certain externalities. The introduction of mechanisation by ARDC in this area in 1971-72 has induced many other fishermen to shift from traditional to mechanised fishing, resulting in increased landings, and creating more employment opportunities, such as in net making, ice plant and work-shop operations, sorting, auctioning, transporting and fish trading. The absence of such economic activities in the neighbouring Elathur village is a pointer to the importance of availability of credit facilities to invest in improved fishing techniques.

Studies made by C.M.F.R.I. on the impact of purse-seine operations on the traditional fishery of karnataka coast (Jacob et al, 1979) shows that, while the production has substantially been increased, the traditional 'Rampani' operation has adversely been affected from the point of view of both income and employment. The Karnataka Government, nevertheless took prompt action to encourage Rampani operators to purchase purse-seines, and, consequently, the intensity of the problem is reduced considerably.

C.M.F.R.I undertook a similar study on the impact of purse-seine operations in Kerala state (1980-81). Unlike in Karnataka, there were only about 60 purse-seines operating in Kerala (Jacob et al, 1982). Manifestation of the purse-seining impact, though noticed, was not on a large scale in 1980. The dwindled availability or decrease in the stock may have affected the catches of the artisanal gears operating in the nearshore waters. The diminished interest shown by artisanal fishermen owing to reduced returns also may have caused a reduction in the landings in 1980. However, in

1981 the oil sardine fishery improved remarkably consequent on better availability and increased effort. From the analysis it appears that the effect of purse seining, at the present level of exploitation and availability, is not tangibly felt on the indigenous fishery off Kerala coast.

A study on the influence of mechanised fishing on the socio-economic conditions of fishermen of Sakthikulangara (near Quilon in Kerala state), conducted by CMFRI during 1981 (Sathiadhas and Venkataraman, 1981), has shown that the influence is manifold. About 7500 persons are currently engaged in fishing and fishery-related activities, compared to about 2000 persons in 1955. The annual income per fisherman household also has risen sharply. However, it is noticed that persons belonging to low-income group do not appreciably benefit from mechanisation.

It may be mentioned here that, in general, machanisation has improved the living conditions and helped in increasing fish production. However, measures are to be taken to involve also the poorer section of fishermen in mechanised fishing and fishery-allied activities by providing them financial and technical assistance so as to ensure a balanced growth of the entire sector.

FUTURE PROJECTION

Currently the exploitation is confined mostly to the coastal zone up to 50 m depth, covering 0 18 million sq. km With the declaration of EEZ, the area available for exploitation in this zone is about 2 million sq. km. Taking into account factors like average annual growth rate of fish production, organic productivity and fish yield per unit area, the potential yield is estimated at 4.5 million tonnes (George et al, 1977). The potential yield of EEZ, broadly grouped into northwest zone, comprising Gujarat and Maharashtra, southwest zone comprising Goa, Karnataka and Kerala, southeast zone, comprising

Table-9 Regionwise area (Sq. km.), potential yield and catch (tonnes) of marine fish in EEZ in India.

Sl. No.	Region	Depth (m)	Area (Sq.km.)	Average annual catch (tonnes)	Potential yield (tonnes)
1.	North west coast	up to 50	90,322		540,000
		,, 200	204,131	484,324	880,000
2.	South west coast	,, 50	23,354		700,000
		,, 200	71,398	503,988	1420,000
3.	South east coast	,, 50	39,862		480,000
		,, 200	72,456	390,501	680,000
4.	North east coast	,, 50	27,001		540,000
		,, 200	46,491	61,831	740,000
5.	Andamans &	,, 50	—		—
	Nicobar	,, 200	16,056	3,196	160,000
6.	Lakshadweep	,, 50	—		—
		,, 200	4,336	4,014	90,000
7.	Total	,, 50	415,000		3,970,000
		Beyond 200	1585,000	1447,854	500,000
8.	Total for EEZ (up to 322 nautical km.)		2,000,000	—	4,470,000

Tamil Nadu, Pondicherry and Andhra Pradesh, northeast zone, comprising Orissa and West Bengal, and areas around Andamans and Lakshadweep islands, together withthe present catch estimates, are given in Table 9. From this table it is clear that the major most contribution is expected from the southwest zone, followed by the northwest, northeast and southeast zones in that order.

Out of about 2 million ha of brackish water area available for fin-and shell-fish culture, only 30,000 ha are

under use at present. The coverage can be expected to go up at least 10% more in the next five years. Apart from this, nearshore open areas up to 18 m depth, covering about 9 million ha, are available for mariculture, such as the culture of edible oyster, mussel, clam, pearl oyster, lobster, crab, fin-fishes and seaweed.

PERSPECTIVES

Since the last five years the marine fish landings in India has not been registering any appreciable increase, indicating that the present area of exploitation may not yield more than one-third of the overall potential. Hence it is imperative that the area of operation is expanded to exploit both conventional and non-conventional species. Studies have clearly shown that resources of tuna and tuna-like fishes, deep-sea cephalopods, prawns and other species are available in our waters. Vessels from far-off countries, such as Taiwan, have been found many times operating off the west coast, which gives a clear indication that fishing in these areas, beyond the presently exploited regions, is economically viable. Though the opearation beyond 50 m depth is capital intensive, we may expect about 300 large vessels to fish here in the near future. At present, apart from the 50 Government of India vessels, there are 55 large vessels operating in the offshore waters. On the basis of the employment potential generated and the fuel consumed by these 55 vessels, it is estimated that increasing the number of large vessels to 300 may result in employment of about 5000 persons, and in the fuel demand going up to 50 million liters, costing about Rs. 180 million.

As seen earlier, there is a tremendous scope in utilizing brackish water and shore areas up to 18 m depth for culture operations. In the case of utilization of brackish water areas of about 2 million ha, it may be expected that a modest

10% of the area would be brought under exploitation, yielding about 80,000 tonnes of fin and shellfish (400 kg/ha) and generating a minimum employment potential of about 0.40 million persons, half of them on contingent basis, in contrast to 5000 skilled persons in the case of larger trawlers. Apart from this, there is a very good scope of employing more persons in mariculture activities in the open sea farming. Blending of capture and culture fisheries in these regions, as shown in the recent studies conducted by the Central Marine Fisheries Research Institute, will enhance the economic returns of rural fisherfolk, which in turn will improve the socio-economic conditions of the coastal fishermen community.

Assuming 300 large vessels would be introduced, the additional yield available from them may be roughly put at 0.10 million tonnes per year. In addition, from the culture side, increasing the area of exploitation to 10% of the total culturable area, the yield may go up to 0.08 million tonnes. Thus, from this expansion one may expect an additional yield of 0.18 million tonnes, resulting in about 12% increase in the production. Even assuming one third of this production might go for exports, still 0.12 million tonnes are available from this sector for local consumption. Thus a total of about 1.40 million.t would become mitigatingly available for local consumption.

HOW TO MEET THE DEMAND

In five years, assuming that 300 larger vessels would be operating then as expected, and that as a result of expanding the area of operation the contribution from capture fisheries from the coastal waters would be increasing to 1.74 million tonnes, the total production from capture side may safely be at 1 84 million tonnes. From well-developed culture systems, production of 1,000 kg ha may not be difficult to get. If it is possible in

the coming five years to raise the culturable area to 20% of the available area and to increase the rate of production to 1000 kg/ha, a production of about 0.40 million tonnes can be achieved. This, together with the production from capture side, would come to about 2.24 million tonnes. Now, assuming that one-third production of larger vessels and one-third that of culture fisheries might go for exports, and allowing 4% of the catch from the coastal waters for fish meal, the quantity that would beavailable for local consumption works out to about 1.82 million tonnes. Taking the population increase after 5 years to be 10%, the marine fish requirement works out to 1.78 million tonnes, demanding a total production of 2.23 million tonnes, which can be met without difficulty according to the above proposal. Itmay be mentioned that the requirement is based on very modest assumptions; with more stringent assumptions the requirements would indeed get pushed up substantially.

As per this projection, the overall production is required to be increased by 54% in the coming five years to meet the demand. This can be achieved only if the area of production from culture operations is increased 14 times and the rate of production to two-and-half times. Apart from this, diversification of fishing, motorization of country craft, extension of fishing area and formulation of proper measures for regulating area and season of fishing too are steps that can lead a long way increasing the catches of smaller mechanized boats.

To make this vision a reality, it is thus evident that concerted efforts need to be taken by the developmental agencies to plan and execute crash programmes, especially on the culture and offshore capture sides, which only would augment fish production, meeting the nutritional demand and generating employment oppertunities, and, finally contributing substantially to the nation's a economy.

REFERENCES

K. ALAGARAJA, K. N. KURUP, M. SRINATH, and G. BALAKRISHNAN, 1982. Analysis of marine fish landings in India, A new approach. Special bulletin No. 10. Cent. Mar. Fish. Res. Inst., Cochin.

K. ALAGARSWAMY, 1981. Prospects for coastal aquaculture in India. Bulletin 30A & B, Cent. Mar. Fish. Res. Inst. Cochin.

ANON, 1973. Proceedings of the Symposium on living resources of the seas around India, Cent. Mar. Fish. Res. Inst., Cochin.

ANON, 1976, Report of the National Commission on Agriculture. Part 8, Fisheries, Department of Agriculture Govt. of India.

ANON, 1977. Indian Fisheries 1947-1977. Marine Products Export Development Authority, Cochin.

ANON, 1981. Marine Products Export Review. Mar Prod. Exp. Dev. Auth. Cochin.

ANON, 1981, All India Census of Marine Fishermen, Craft and Gear: 1980, Mar. Fish. Infor. Ser. No 30, 1981. Cent. Mar. Fish. Res. Inst. Cochin

ANON, 1981. Hand Book on Fisheries Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Govt. of India, New Delhi. pp. 104.

ANON, 1982, Trends in Marine Fish Production in India-1981 Mar. Fish. Infor. Ser. No. 41. Cent. Mar. Fish. Res. Inst, Cochin.

ANON, 1983. Proceedings of the Workshop on acquisition and dissemination of data on marine living resources of Indian Seas, Mar. Fish. Infor. Ser. No. 46, Cent. Mar. Fish. Res Inst, Cochin.

ANON, 1984. Price Indicator of Marine Products Exports (PRIME) Vol. VIII (31). Mar. Prod. Export. Dev. Auth., Cochin.

P. C. GEORGE, B. T. ANTONY RAJA, and K. C. GEORGE, 1977 Fishery resources of the Indian Economic Zone. Souvenir, Integrated Fisheries Project Silver Jubilee Celebrations, Cochin.

M J. GEORGE, C. SUSEELAN, and K. BALAN 1981. By catch of the shrimp fishery in India. Mar. Fish. Infor. Ser No. 28, Cent. Mar. Fish. Res. Inst., Cochin.

C. GOPALAN, B. V. RAMASASTRY and S. C. BALA SUBRAMANIAN, 1971. Nutritive value of Indian foods, National Institute of Nutrition (ICMR), Hyderabad.

T. JACOB, S. K. DHARMARAJA, and K. K. P. Panikkar, 1979. Socio-economic implications of purse-seine operations in Karnataka. Mar. Fish Infor. Ser. No. 12, Cent. Mar. Fish. Res. Inst, Cochin.

T. JACOB, K. ALAGARAJA, S K. DHARMARAJA, K. K. P. PANIKKAR, U. K. SATYAVAN, G. BALAKRISHNAN, V. BALAN, and K. V. N. RAO. Impact of purse-seine operations on traditional fishery with special reference to oil sardine in Kerala during 1980 and 1981. Mar. Fish. Infor. Ser. No. 40 Cent. Mar. Fish Res. Inst., Cochin.

K. K. P. PANIKKAR, 1980. Coastal Rural Indibtendness - A case study, Mar. Fish. Infor. Ser. No. 18, Cent. Mar. Fish. Res. Inst., Cochin.

K. K. P. PANIKKAR, and K. ALAGARAJA, 1981. Socio-economic status of fishermen community of Calicut area. Mar. Fish. Infor. Ser. No. 33, Cent. Mar. Fish. Res. Inst. Cochin.

K. K. P. PANIKKAR, and R. SATHIADHAS, 1982. Fishermen share in consumers one rupee. Proceedings of Symposium on harvest and post-harvest technology of fish, Cent. Inst. Fish. Tech., Cochin.

R. SATHIADHAS, and G. VENKATARAMAN, 1981.

Impact of mechanised fishing on the socio-economic conditions of the fishermen of Sakthikulangara-Neendakara, Kerala, Mar. Fish. Infor. Ser. No. 29. Cent. Mar. Fish. Res. Inst.. Cochin.

E. G. SILAS, S. K. DHARMARAJA, and K. RENGARAJAN, 1976. On the exploited marine resource of India, a synoptic picture. Bulletin No. 27, Cent. Mar. Fish Res. Inst., Cochin.

S. K. TRIPATI, 1981. Rural aquaculture projects and its impact on the development of rural areas. Bulletin 30A & B, Cent. Mar. Fish. Res. Inst , Cochin.